THE TEXTILE MUSEUM Journal

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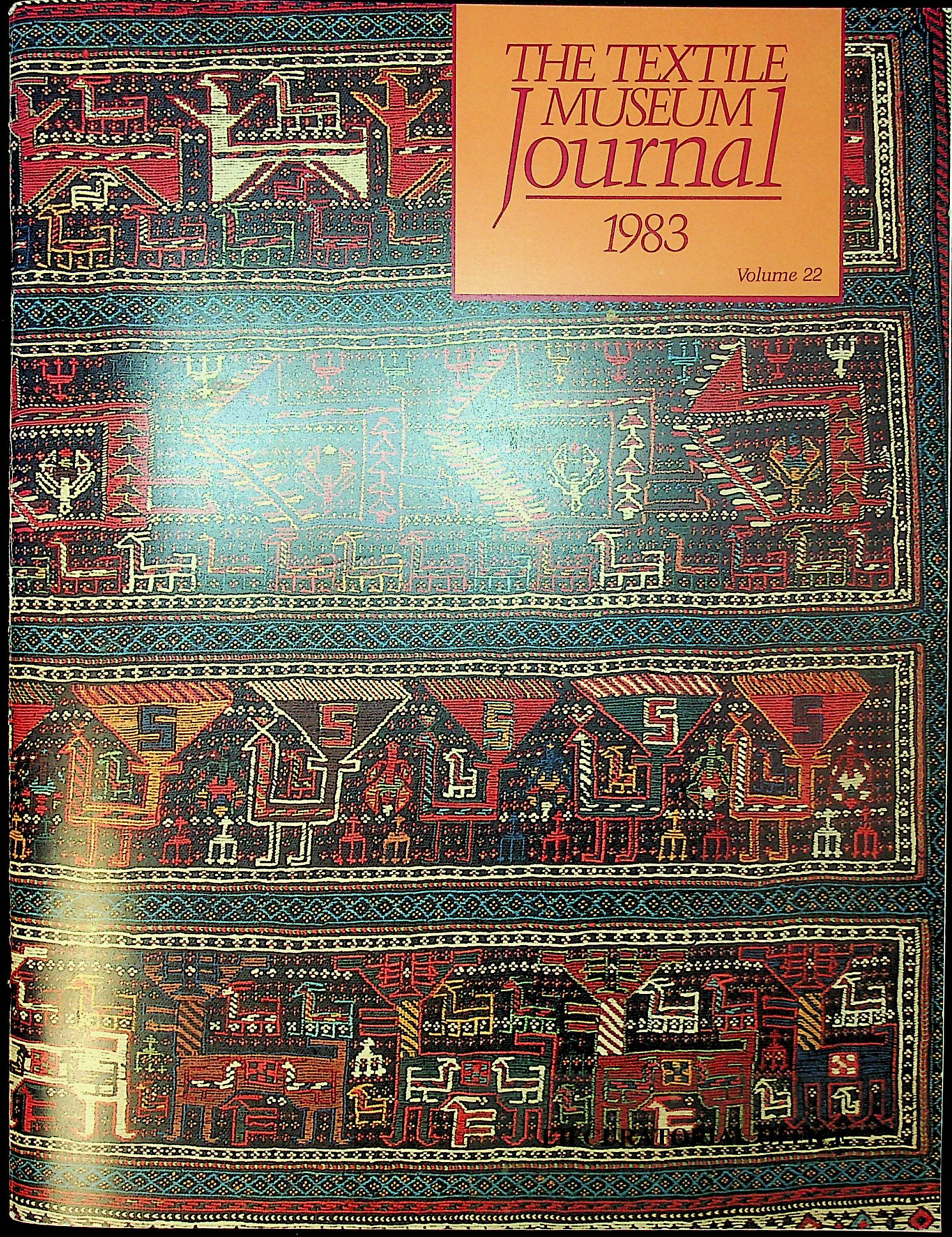
Volume 22



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Cover: Detail of a South Persian horse blanket from the Fars area, probably Qashqai. Arthur D. Jenkins Collection

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Warping And Weaving Mitla Cloth On The Backstrap Loom

Maaike Knottenbelt

To a person not familiar with the mechanics of a backstrap loom, Mitla cloth looks like any one of a number of fairly unprepossessing multi-shed weaves which can be found in a variety of contexts around the world. Its structure in relation to a backstrap loom, however, is anything but unprepossessing. The warping sequence is a highly complex arrangement of threads, whose very complexity would seem to assure its demise. According to Irmgard Weitlaner Johnson:

> "In 1957 only five weavers (men) knew how to weave this cloth, and only four Indians (men and women) knew how to warp the complete traditional pattern."[1]

What makes Mitla cloth so interesting on a backstrap loom as opposed to a treadle loom, is that for this cloth a backstrap loom is warped with at least two continuous warp threads. The threads are not simply warped in a figure 8, and then cut at one end to be fed through the respective heddles as with a treadle loom. Rather, the weaving draft is established on the warping board: the threads are not cut, but each one—both coming and going on the board—must contribute to the final cloth design. This casts a rather different complexion on the warping for a multi-shed weave than that with which most Western weavers are familiar.

Through the Oaxaca office of Fonart—Fondo Nacional Para el Fomento de las Artesanias—I was put in contact with Noel and Adolfo Morales Quero at Mitla. Although Noel weaves Mitla cloth on a treadle loom, Adolfo has woven Mitla cloth on a backstrap loom—so he told me—for 25 years. He is one of the few who still knows how to set up Mitla cloth on a backstrap loom, and his skill at handling this weave structure is extraordinary. From start to finish, Adolfo could have warped, dressed a loom, and woven a sample piece in two hours, if I had not held up the weaving process by wanting to do it myself.[2] Part of this impressive speed, I suspect, was to make sure that I understood as little as possible of the all-important warping process until the matter of money had been settled. But once that matter was cleared, Adolfo proved as adept a teacher as a weaver, with an enlightening and flexible understanding of the basic cloth structure. In view of the large number of variables which must be remembered to complete this warp-patterned weave, it is impressive indeed that it was developed in an oral tradition. What Mitla cloth shares with the backstrap loom weaves from only two other areas,[3] is a singularly inventive use of the warping sticks as well as the weaving sticks, in establishing the patterned designs. Warping holds the key: and although this is fairly obviously the case with all loom produced cloths (i.e., in the sense that if one does not have a correctly prepared warp, one cannot effect the desired results), the particular use of warping sticks with Mitla cloth opens up a quite different perspective as to the capacities of, and the relationship between, warping and weaving sticks.

The aim of this article is to demystify the technical process involved in making Mitla cloth. Consequently its organization follows those steps involved for the weaver, from an initial assembly of the particular warping and weaving sticks, to a brief discussion of the materials used and an overview of the cloth structure. This is followed by the actual warping, loom dressing, and series of movements which effect the woven cloth. Once the steps are spelt out in this sequence, an extraordinarily complex process in oral tradition logics becomes rather more accessible.

In the past, Mitla cloth was woven in skirt lengths, either for local use or for trade to different villages.[4] As such, eight warping posts were used to establish the cloth length, with the posts either secured in a warping board or driven directly into the ground. The arrangement of warping posts would appear as in Fig. 1. For our shorter sample warps, Adolfo and I used only six warping posts, arranged as in Fig. 2. Whatever the cloth

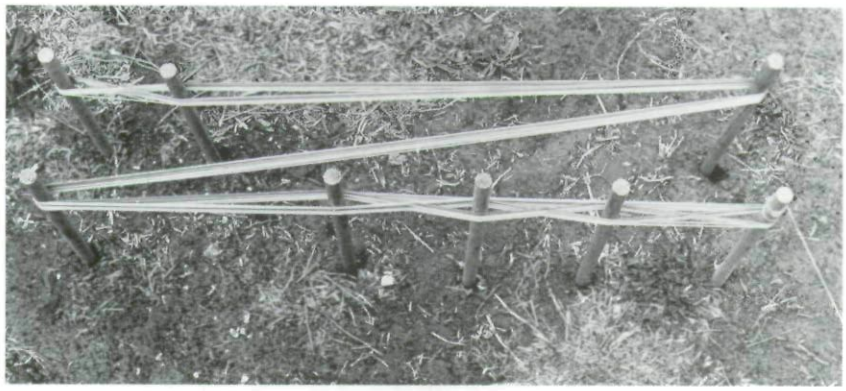


Fig. 1 Traditional arrangement of warping posts for Mitla cloth skirt lengths.

Fig. 2 Arrangement of warping posts for a shorter warp.

length, it was made clear that six warping posts minimum, divided into two groups, were needed to establish the Mitla warp. Those four warping posts representing the front warp beam and post numbers 1, 2, and 3, had to remain together as a group at one end of the warp. The two further warping posts representing the back warp beam and plain weave shed cross, had to remain together at the opposite end of the warp. More posts to provide extra length could be inserted at intermediate positions between these two groups, but the position of the two groups at either end of the warp was fundamental.

The loom pieces needed were similar to many encountered in backstrap looms from other areas, although there were also some differences. Three sticks, approximately 2cm thick, of equal length and with wedge-shaped ends, were used for a back warp beam, front warp beam and cloth beam. Another stick, slightly smaller in diameter and length and with no end shaping, was used during loom dressing to secure warp threads to the back warp beam. Two heddle sticks were used for our sample warps, although three heddle sticks would have been necessary for weaving four selvedge cloth. Three beaters were used—all of equal length and fashioned from a light-weight wood. A shuttle stick, bamboo tenter, tie-rope and backstrap, completed the requisite number of loom pieces for this particular weave.

The material traditionally used to fashion Mitla cloth was wool, handspun and dyed with a variety of native dyes. However, time and economics have seen this change to store-bought cotton yarns in the early 1970's, and, sadly, acrylics in the early 1980's. The advent of acrylics has successfully annihilated the production of Mitla cloth on a backstrap loom replacing it with production on a treadle loom, for the soft twist of acrylic yarn cannot be usefully accomodated as such to the requirements of the former.[5] Irmgard Johnson has some fascinating information about the local dyes and mordants formerly used with the hand-spun yarns: she mentions in connection with this particular cloth:

> "Two shades of cochineal-dyed yarns are obtained: (a) that spun of white wool and dyed with cochineal, becomes light rose-red in color; (b) that spun of white wool carded with a bit of black wool (gray yarn), when dyed becomes dark wine red. These two yarns of contrasting shades are used in the pattern of the ceremonial red skirt (*manta colorada*)."[6]

According to Johnson, the traditional *manta colorada* was composed of four differently colored yarns, although Adolfo indicated that he felt one could use anywhere between two to five colors to effect the weave technically. For our sample warps we used two differently colored cottons approximately equal to a $^{32}/_{15}$ netting cotton. The advantage in using only two colors for learning purposes, I thought, was the clear contrast established between design and background. Adolfo in fact thought two colors made the learning process more difficult than many colors; if we had had the yarn, he would have chosen to use a different color for each design. It became clear that no difference in technical expertise was required whether two or more colors were used; many woven samples contain three colors, and it would seem that different weavers have different ways in which they choose to use color for a dominant or background effect. The density of the warps in different samples was also found to vary, from 9 double warp ends per cm on a fine old woollen piece to 6–7 double warp ends per cm on many of the cotton samples. Even now, only ten years later, the cotton samples are seen as very fine compared to the acrylic treadle loom jackets and rebozos (shawls) presently produced for tourist sale—which indeed they are.

Visually speaking, there are four patterns on the manta colorada: Cocol, Maiz (or Maiz-

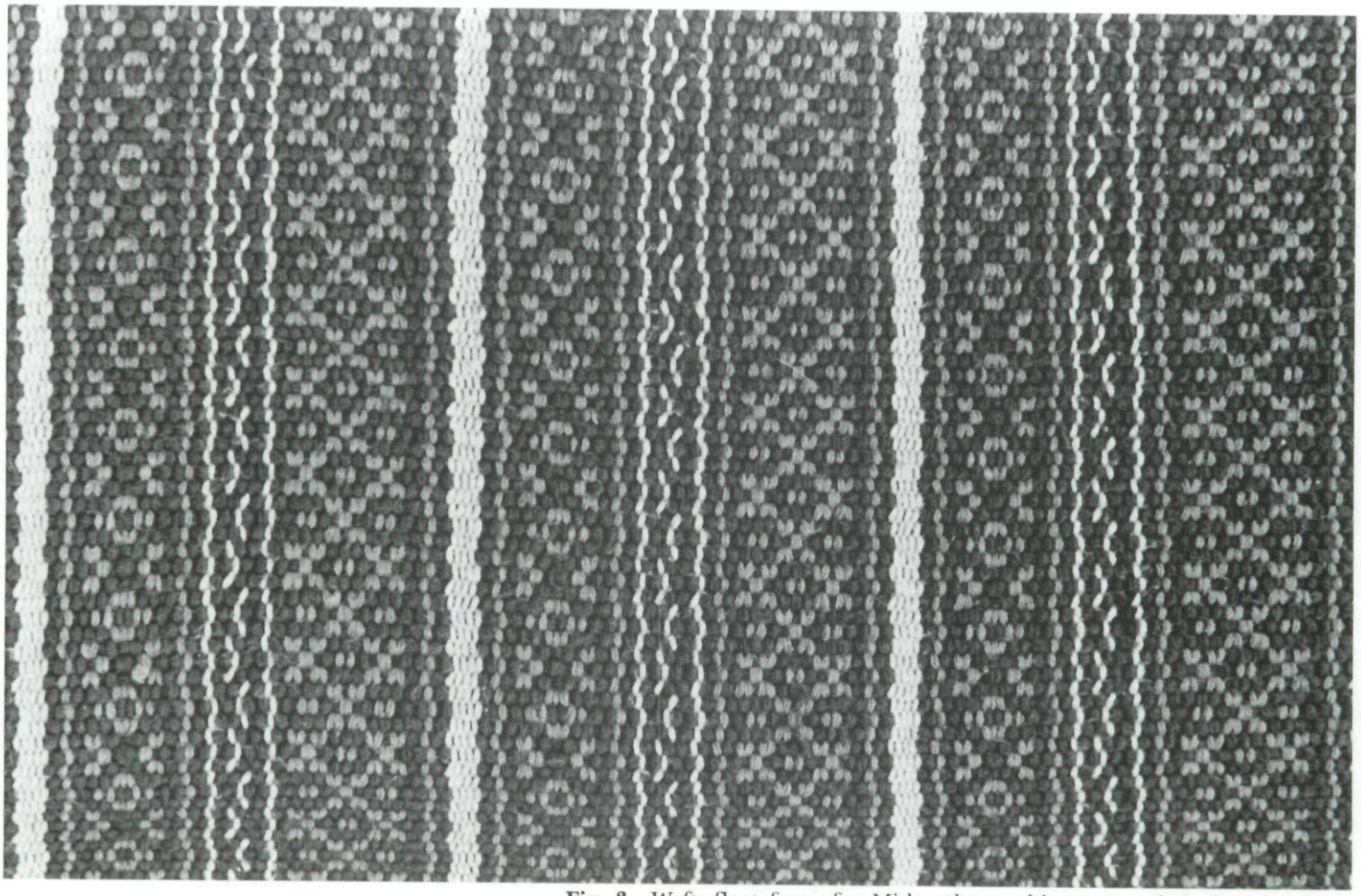


Fig. 3 Weft–float face of a Mitla rebozo: this reverse cloth face develops uppermost while weaving. Pattern units from the left are: Fondo, Cocol, Rayas, and Maiz.

itos), Rayas, and the foundation weave—or fondo—which works on a color inversion principle to effect a pattern stripe.[7] Each pattern is separated from those on either side by the foundation weave. Sometimes this foundation weave contains a three thread contrast color stripe. The basic weave structure is 2/1 twill. The fondo is a horizontal herringbone with frequent reversals, and the patterns are diamond twill. The 3/1 and 1/1 interlacings are caused by the reversals of the twill diagonals.[8] See Figs. 3 and 4. Adolfo did not feel that the fondo actually qualified as a pattern per se, and ostensibly he taught me only three designs. What he continually stressed throughout the lessons was the basic weave structure established around the warping posts designated 1, 2, and 3. Structurally he is correct, for the warping sequence of the fondo is the same as the terminating borders and the basic warp structure of the whole cloth. Nevertheless, both visual and structural perspectives offer useful information as to the different artistic interpretations one encounters, and the technical framework within which they are effected.

Our first warping lesson proceeded at an electric pace, with Adolfo raising a masterly yet quizzical eyebrow when I asked him to please slow down—I wasn't understanding. At the second warping he put aside his virtuoso performance and concentrated on making the process clear. We inched our way through recording diagrams which detailed the path of each warp thread for each design, and all of us (Adolfo, Noel, Noel's wife and I) relaxed audibly as the diagrams were tested and found accurate by further warping. But although Adolfo accepted the thread diagrams as one method of understanding, it was not the method that primarily interested him. Detailing the path of each warp thread for each design was a laborious and long-hand method of working around an axiomatic point. The point he stressed continually throughout the lessons was:—watch the posts which he called 1, 2, and 3. The shed crosses were not important. What happened between the posts was

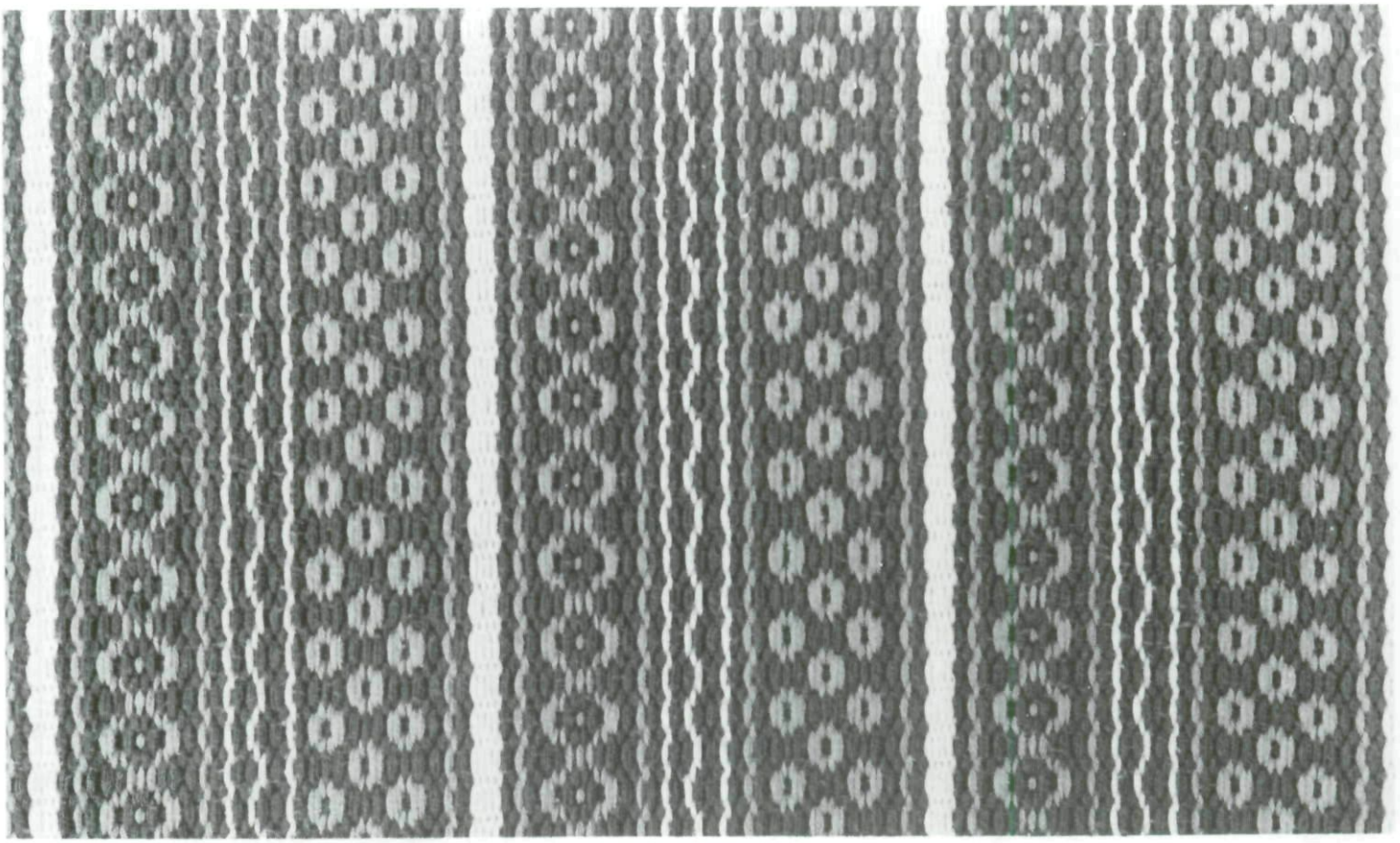


Fig. 4 Warp–float face of the same rebozo. This front cloth face from which the pattern units take their names, develops underneath. From the left, pattern units are: Fondo, Cocol, Rayas, and Maiz.

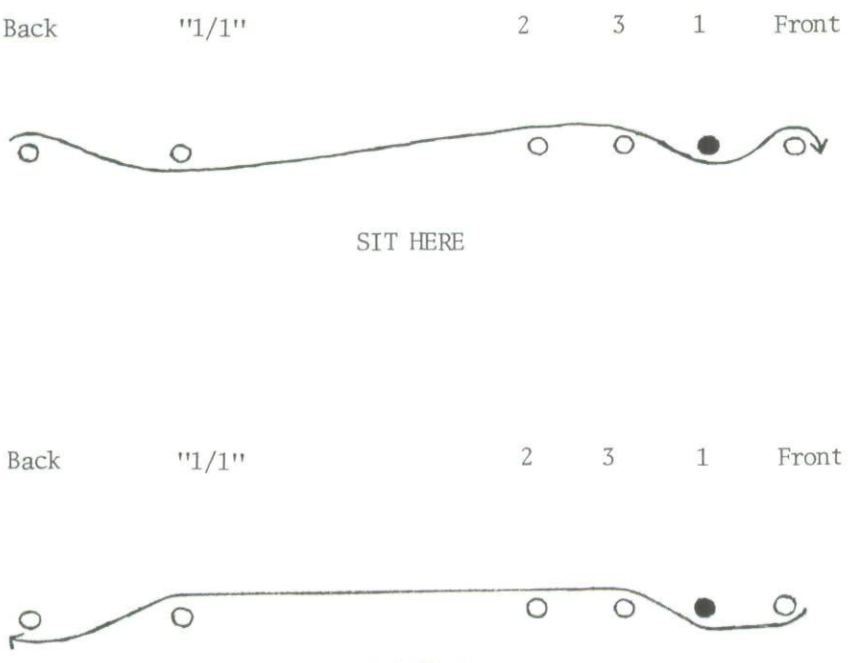


Fig. 5 Both warp threads pass in front of post 1 and behind posts 2 and 3, relative to the warper's position at the board.

not important. Watch the posts 1, 2, and 3.

My initial response was incomprehension. To suggest that shed crosses were not important while warping for a backstrap loom seemed downright heretical. Yet this apparently heretical statement held the key to a flexible and rapid warping: the order in which the warp threads passed around these three pivotal posts was critical to establishing the warp set. Posts 1, 2, and 3 in fact controlled those three shed openings which effected the twill weave.

Adolfo's emphasis on posts 1, 2, and 3 referred to the position of each warp thread on the board, whether it passed in front of, or behind one of these three posts. The concepts "in front of," and "behind," were used to describe the position of each warp thread on the posts *relative to the warper's position at the board.* For example, in Fig. 5 both warp threads would have the same shed value when weaving the cloth, although they ostensibly appear dissimilar because they travel in opposite directions on the warping board. But relative to the warper's position at the board, both threads pass in front of post 1 and behind posts 2 and 3. When the loom is dressed ready for weaving, all those threads passing in front

of post 1 would be secured by heddle rod 1, and the direction of warp threads on the board lose all significance.

The same principle applies to those threads that pass in front of post 2, relative to the warper's position at the board (see Fig. 6). If the threads pass in front of post 2 and behind posts 1 and 3, they would be secured on the loom by beater number 3 acting as a shed stick.[9] Again, the difference in thread direction on the warping board would have no significance when the warps are transferred to the loom. The important point is which of the three posts the thread passes "in front of," for this factor determines which heddle rod or beater will secure those warps on the loom.

Those threads passing in front of post 3 on the warping board (see Fig. 7) would be secured on the loom by the second heddle rod. Both threads in Fig. 7 would have the same shed value when weaving, for relative to the warper's position at the board, both pass in front of post 3 and behind posts 1 and 2.

When the correlation between posts 1, 2, and 3, and the corresponding loom pieces became clear, the thread passage at the "back" and "1/1" posts was very simple. No matter which post of the 1, 2, 3 sequence was being circled, the warp threads always passed behind the "1/1" post and in front of the back (warp beam) post when travelling from the front (warp beam) post. As the thread travelled towards the front post, it would circle behind the back warp post and in front of the "1/1" post (see Fig. 8). This gave a plain weave shed cross between the "back" and "1/1" posts which was used in our samples for loom dressing only. For the weaving of four selvedge cloth, this shed cross could have been secured by a third heddle stick and used to weave a heading before loom reversal. The heddle stick would have then been loosely fastened to the back warp beam, to be used again when effecting the terminal weaving between the two-shed heading and the three-shed patterned weave. The use of a third heddle rod for the terminal weaving is confirmed by Elsie McDougall's observations at Mitla in 1935-36 as quoted by Johnson: "A peculiarity of the Mitla weave is the shed action of 3 sets of healds, 3 sword like sticks, no round shed rod."[10] However, a loom in the Textile Museum collection (Fig. 9) and a photograph published by Johnson[11] indicate that such a heddle rod was not invariably used, or that it was sometimes not made until the weaver was ready to begin the terminal weaving.

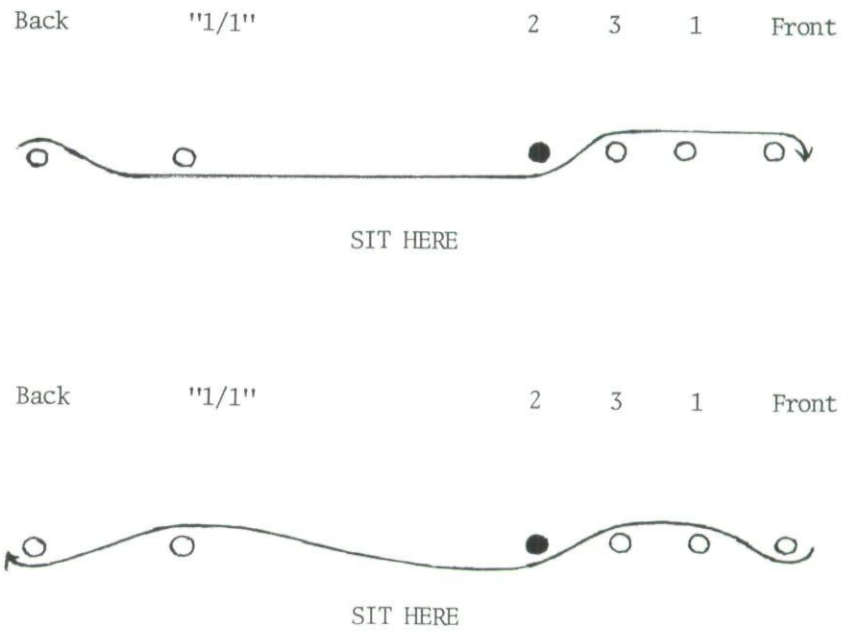


Fig. 6 Both warp threads pass in front of post 2 and behind posts 1 and 3. Differing thread directions on the warping board will hold no significance on the loom.

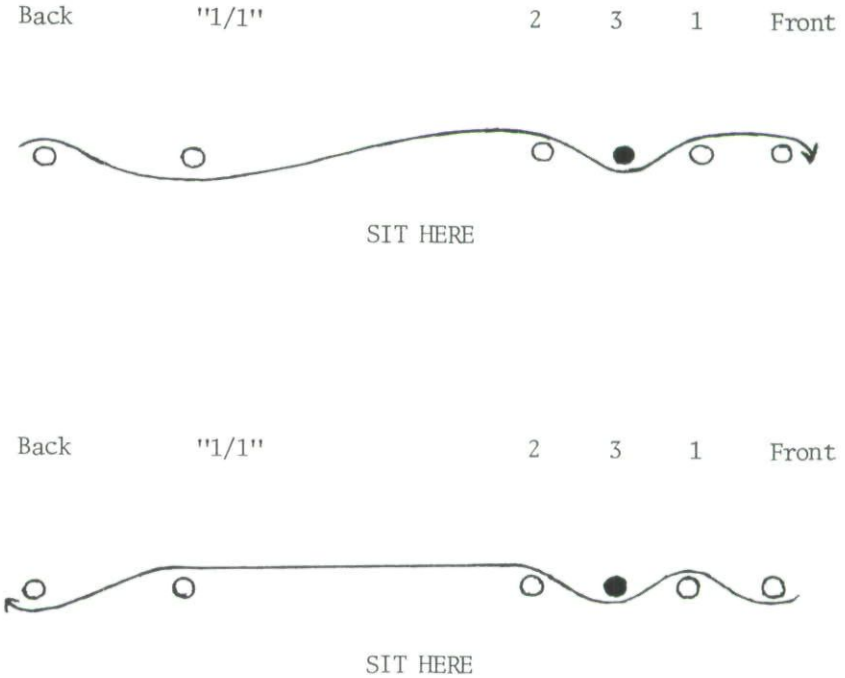
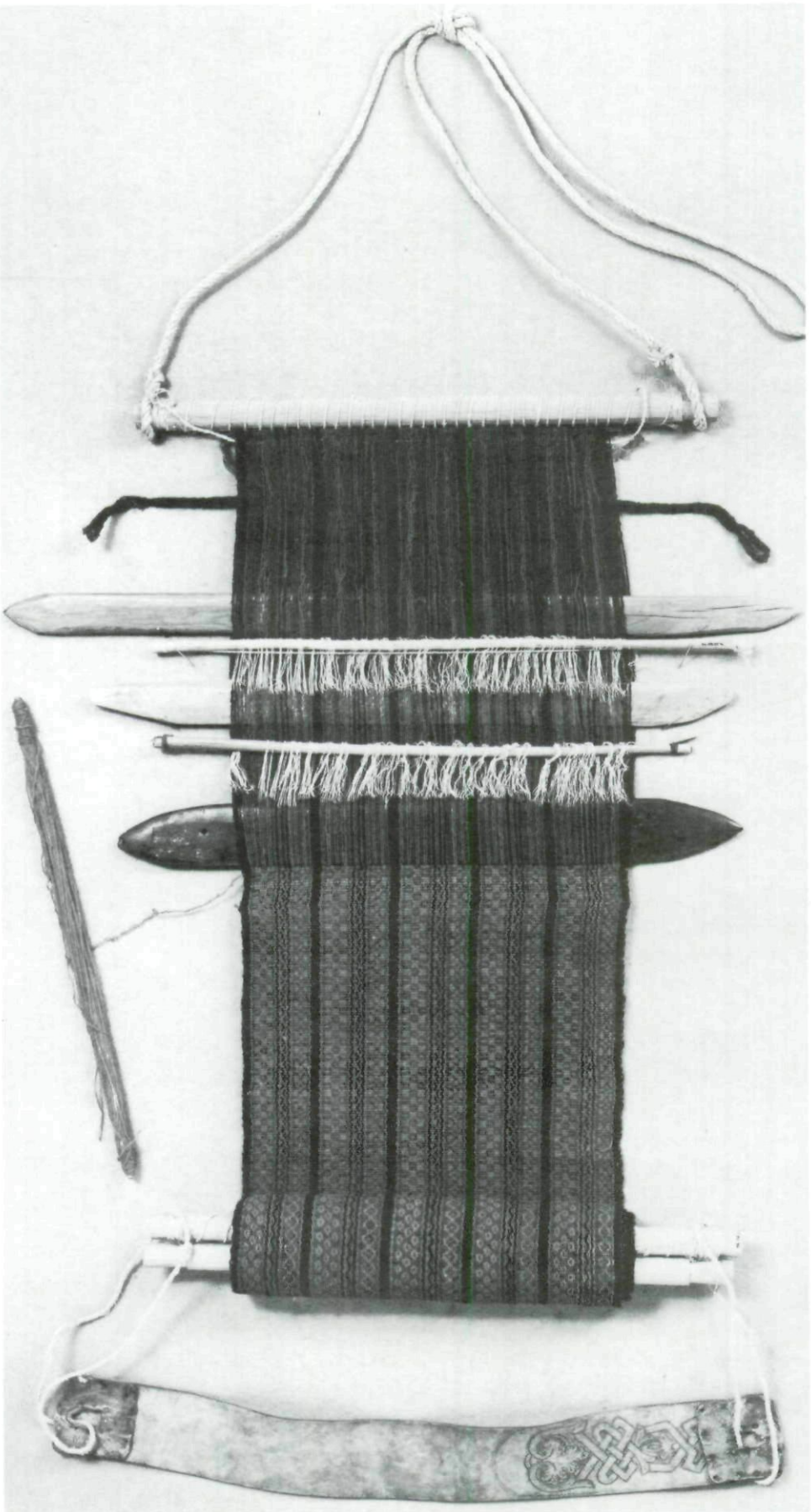


Fig. 7 Both warps pass in front of post 3 and behind posts 1 and 2. They will be secured on the loom by heddle 2.

Fig. 8 Establishing a plain weave shed cross at the other end of the warp.

Fig. 9 A Milta loom for skirt fabric with warps lashed at both front and back warp beams for four selvedge weaving. Textile Museum 87.18. Collected in 1958.



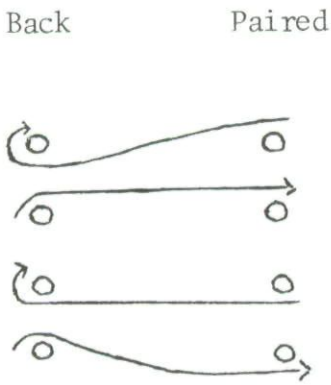


Fig. 10 Establishing a shed cross with paired warps.

In her discussion of skirt production at Pinotepa de Don Luis, Diana Ryesky indicates that threads are warped in pairs at the back warp post.[12] This would in no way affect the movement of threads around posts 1, 2, and 3. It would simply mean that they follow a different course *between* post 2 and the back warp post, repeating a four thread sequence rather than a two thread sequence (see Fig. 10). Although nobody weaves four selvedge cloth at Mitla today, nor have they done so for some time, it appears from Adolfo's ½ warping that the terminal weaving of Mitla skirts would not have corresponded to the practice in Pinotepa de Don Luis. This suggestion is supported by a Mitla skirt in the Textile Museum collection (1976.23.3) which has paired wefts in its terminal weaving, but single warps which are only occasionally and irregularly paired.[13] The occasional pairing would be due either to not using a heddle rod at all, or to the difficulty of opening a shed in such a short length of warp.

With the different warping emphases clearly established, the thread sequence for the fondo (or foundation weave) became directly available. One simply warped in front of posts 1, 2, and 3 in succession, and continued to repeat this sequence. Whether the sequence began from the front or back warp post made no difference, so long as the threads passed in front of posts 1, 2, and 3 in the same order (see Fig. 11). To warp the three thread contrast color stripe, one simply altered the warp color but continued the same 1, 2, 3 warping sequence.

Rayas also utilized the basic 1, 2, 3 warping sequence, but design color was interspersed with foundation color to pick up a (2) (1) (3) design sequence. That is, two colors were needed consecutively to warp Rayas, with the warping sequence looking like this:

Fondo	1 2 3
Rayas	1 (2) 3 (1) 2 (3)
Fondo	1 2 3

Two consecutive colors were also needed to warp Maiz and Cocol, but neither of these designs followed a basic 1, 2, 3 sequence, either in foundation thread or design thread. The warping sequence for Maiz was:

Fondo	1 2 3
1st Maizito	1 (2) 3 (2)(1) 3 (1)(2) 3 (2)
2nd Maizito	1 (3) 2 (3)(1) 2 (1)(3) 2 (3)
3rd Maizito	1 (2) 3 (2)(1) 3 (1)(2) 3 (2)
Fondo	3 1 2 3 etc.

Note that the third Maizito repeats the warp sequence of the first. One could make the pattern unit wider by repeating the sequence of the first two Maizitos before warping more foundation, and most cloth samples in fact contain somewhere between 3-6 Maizitos in each pattern unit.[14]

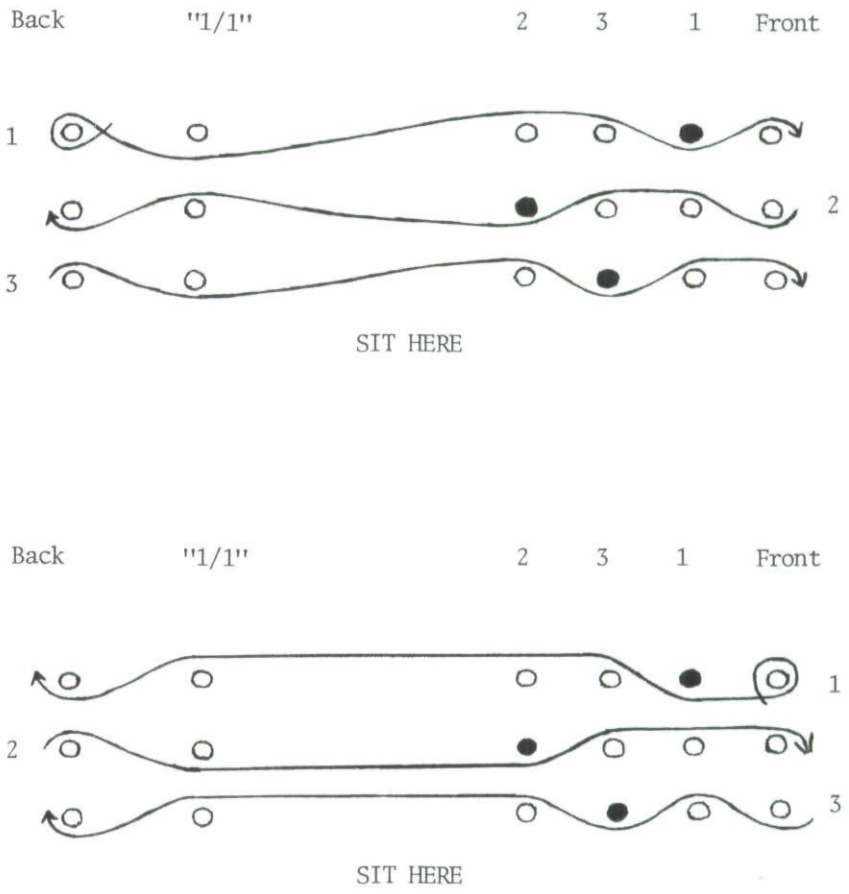


Fig. 11 Warping the foundation weave: both sequences have the same shed values when weaving.

Cocol was warped according to the following schema:

Fondo	1 2 3
Cocol	1 2 (3) 2 (3)(1) 2 (1) 3 (2) 1 (2) 1 (2) 3 (1) 2 (1)(3) 2 (3)
Fondo	1 2 3 etc.

The overall sequence in which these pattern units were combined was found to vary on different samples, with different weavers creating different emphases by particular color use and their sequence of succeeding patterns. In all examined samples, the Rayas pattern was contained on either side by a 3-thread contrast color stripe in the foundation weave, although one sample had a 6-thread contrast color stripe. As in backstrap loom weaves from other areas, a certain amount of artistic license was found within the clearly defined technical parameters.

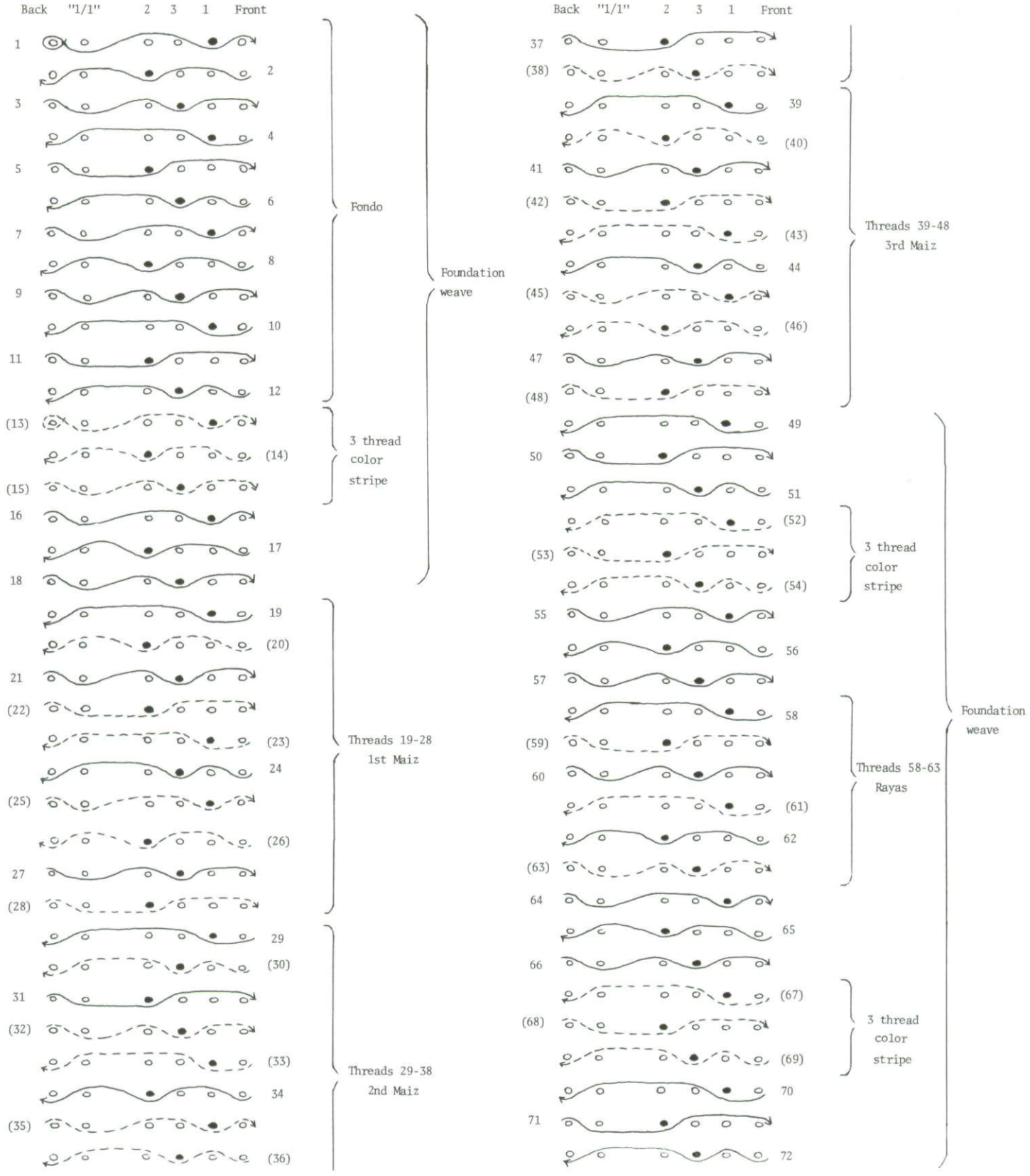
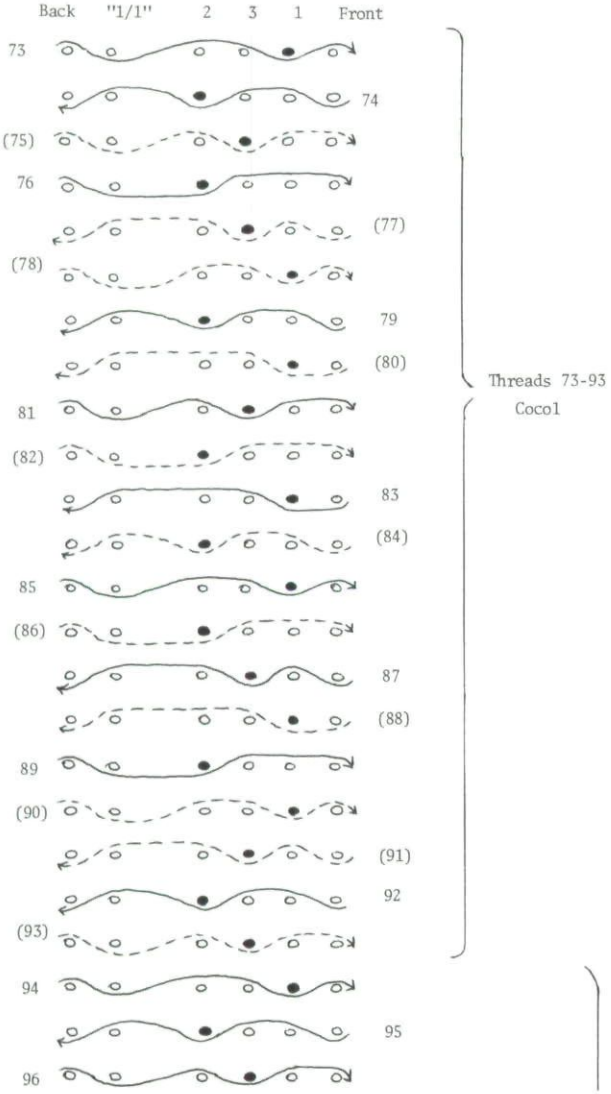
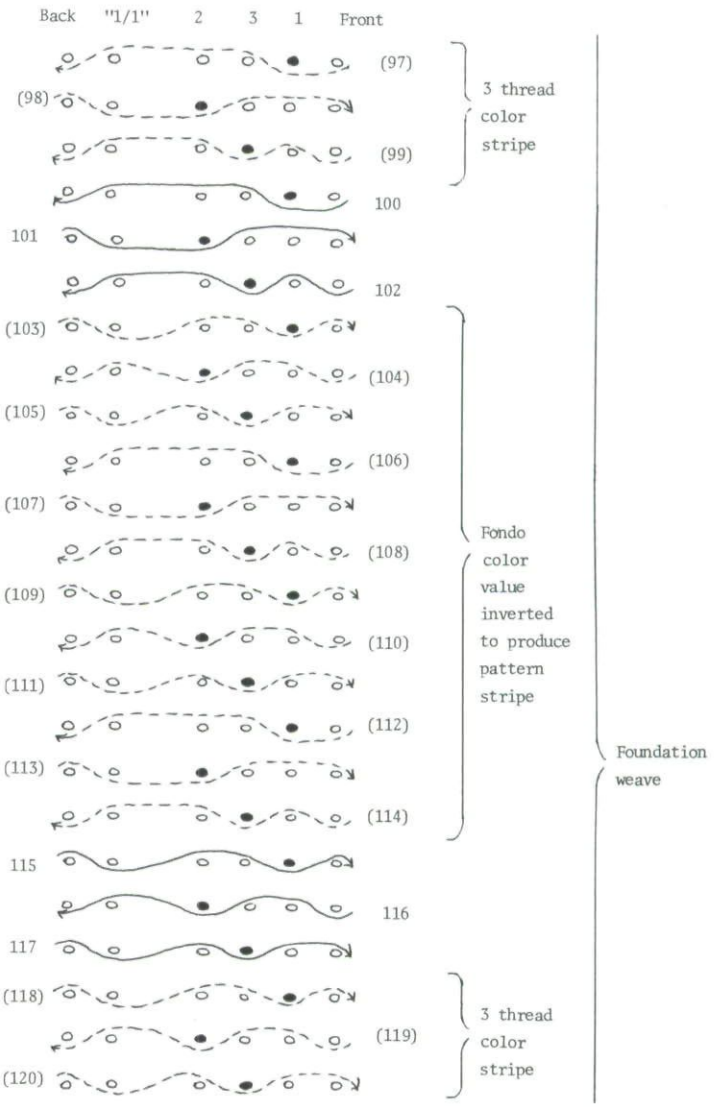


Fig. 12 Sample warping diagrams of each pattern unit.





Key to Warping Diagrams.

1 — Foundation thread

(13) — Pattern thread

○ ● ○ — Blacked post indicates 1, 2, 3 sequence

Sit in relation to the warping board as indicated by the diagram:

NOT HERE

1

SIT HERE

The sequence is then repeated from thread 16. Note that while foundation thread 121 travels in the opposite direction to foundation thread 16, reference to the blacked posts of the 1, 2, 3 sequence will maintain correct warping. The pattern threads repeat the path of the earlier pattern threads exactly.

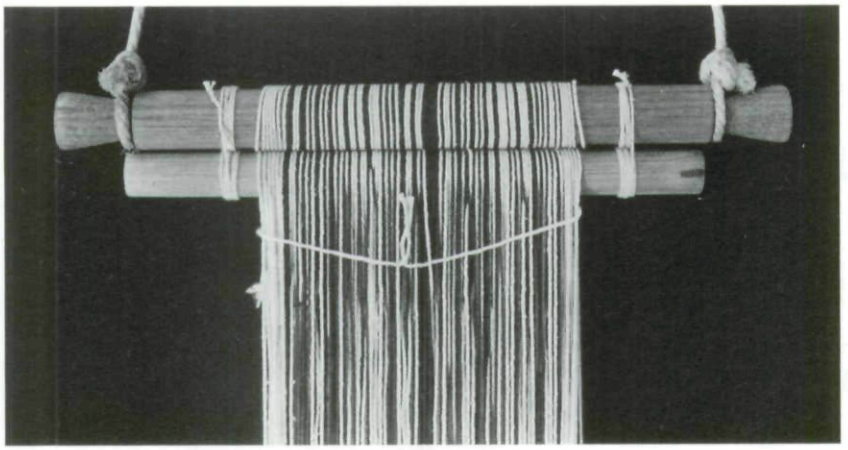


Fig. 13 Warp threads are held in position at the back warp beam by a securing rod through the plain weave cross.

While the 1, 2, 3 warping explanation was certainly the most concise yet flexible perspective, it relied for its ease of handling on a very clear mental picture of the cloth structure and its overall visual appearance. This familiarity is more easily attained by those people at Mitla who come in constant contact with the cloth, than it is by others who do not see or handle the cloth very often. For this reason, long-hand diagrams detailing the passage of each warp thread on the board would also seem to have their explanatory use; the diagrams are a more graphic representation and make the warp sequence immediately available (Fig. 12). While they may appear to stress rather than minimize, thread direction on the warping board, the 1, 2, 3 logics can be illustrated by blacking the appropriate post of the sequence for each warp thread. The diagrams can thus serve as an intermediate step in making the numerical system clear. However, in detailing sample diagrams here of each pattern unit, it must be remembered that different Mitla weavers could choose different overall emphases as to color, relative pattern position, and width of some component elements.

With the warping complete, the shed divisions were secured at each of the six warping posts by two long shoelaces acting as lease cords. One shoelace secured the "1/1" cross, and the other was successively and loosely half-hitched through the thread divisions at posts 1, 2, 3, and the front warp post. The warp was then removed from the board, and the front and back warp beams inserted through the shed divisions at either end. The front warp beam was attached to the tie-rope and the back warp beam to the backstrap; this ensured that warp threads were sorted first at the "1/1" cross.

A beater was inserted in the shed division held by the lease cord behind the shed cross, and the warp threads were then sorted in consecutive sequence. Because there were two consecutive color threads used during warping, the warps did not always lie in simple sequence as for an ordinary plain weave warp; any cross-overs between colors were brought close to the back warp beam. If we had been weaving four selvedge cloth, at this stage we would have added a heddle rod to secure those upper warps in front of the plain weave shed cross and made a lashing to secure the warps to the back warp beam. As we were not, Adolfo had a faster method of loom preparation. That loom piece slightly shorter and narrower than the back warp beam was inserted through the same shed clearance as the beater. The beater was then removed and the loom piece brought close against, and secured to, the back warp beam. Although the small loom in Fig. 13 shows a securing at either side of the warp threads only, our wider samples at Mitla were secured in the center as well.

The loom was then reversed and the back warp beam attached to the tie-rope, the front warp beam to the backstrap. Beaters were inserted in their appropriate shed divisions, with the first beater securing those threads held by the lease cord above the first shed cross. This meant in effect, that those warps which, on the warping board passed in front of post 1, now lay over beater 1. The second beater was inserted through the shed division held by the lease cord above the second cross, securing thereby those warps which had passed in front of post 3. Beater 3, inserted through the shed division above the third cross, secured those warp threads which had passed in front of warping post 2.

The threads were then sorted in consecutive sequence at this end of the loom, and two separate heddle rods added to secure those warp threads lying over beaters 1 and 2. The method of making heddles was the familiar one where a continuous heddle string catches alternate warps in front of and behind the heddle rod. Heddles were made slightly longer than is usual for most backstrap loom weaves, the reason being that beaters, which are wider than shed rolls,[15] were used to effect the shed changes. Shorter heddles would have resulted in the continual inefficiency of beaters slipping flat during a shed change. When the heddles were complete, a guard string tied

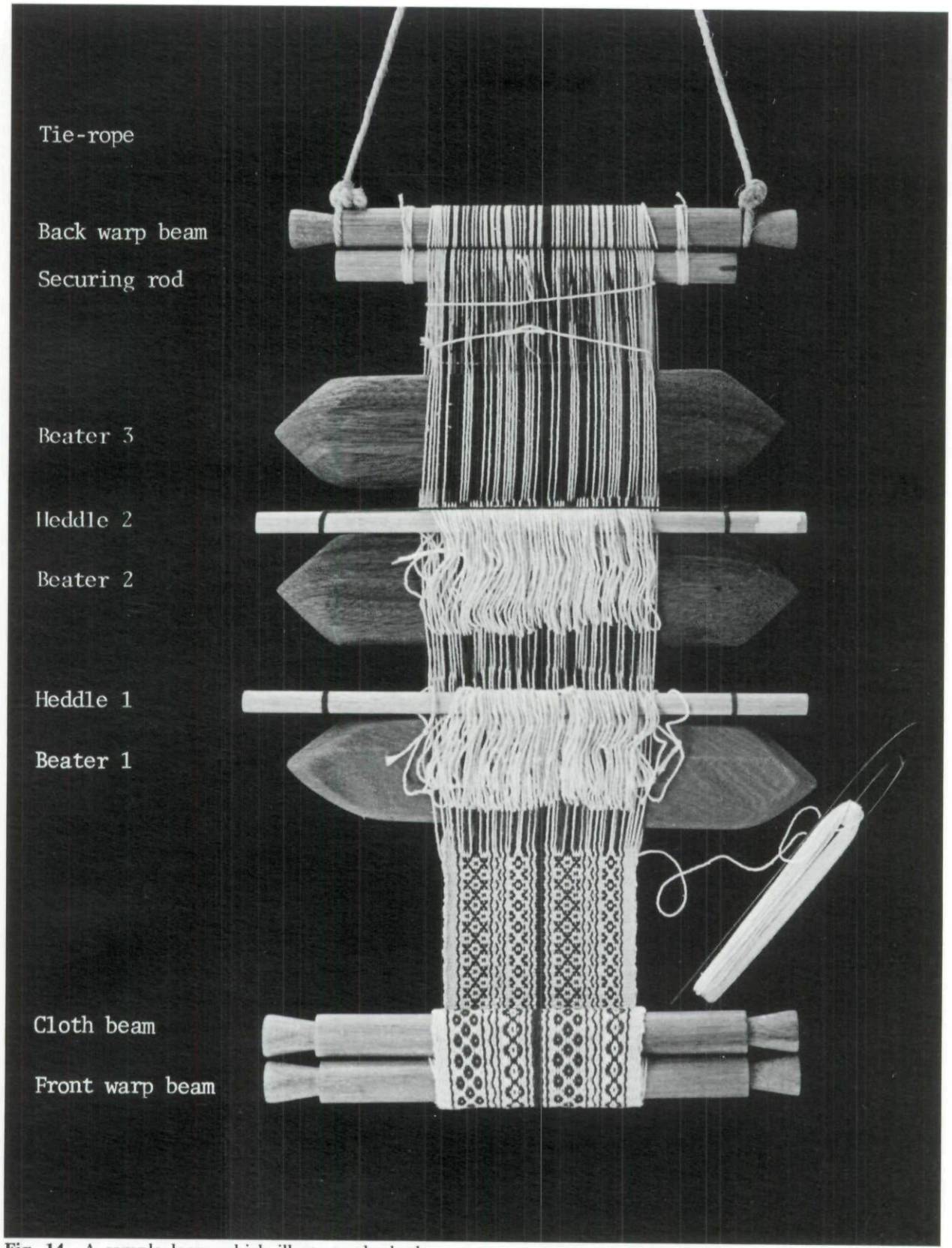


Fig. 14 A sample loom which illustrates both the relative position of loom pieces during weaving, and a warp set up according to the pattern sequence given in Fig. 12. The shuttle is not of Mexican origin.

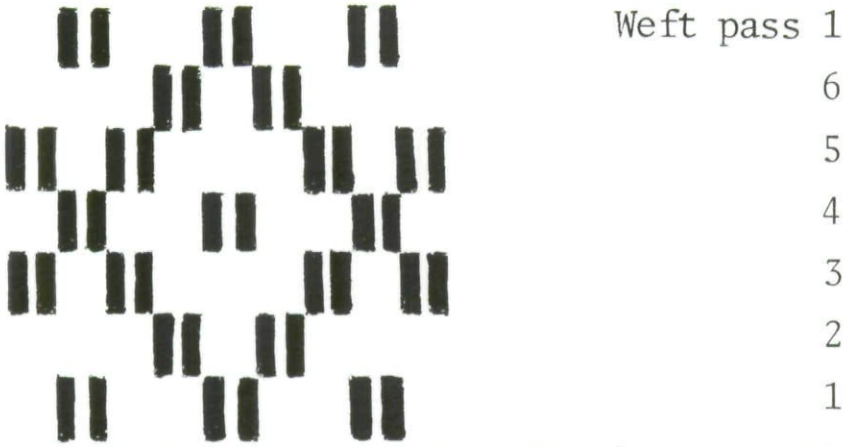


Fig. 15 By reference to the inverse of Maiz, correct weft pass sequence can be maintained.

across each rod prevented the rods from falling out.

At this stage all lease cords were dispensed with except that one holding the shed division also held by beater 3. This lease cord remained in position throughout weaving, but was re-tied beneath the warps so as to present minimum interference.[16] The warp threads were then centered on the front warp beam, and, as with the back warp beam preparation, would have been lashed with a heading cord if weaving four selvedge cloth (see Fig. 14). The faster method which we used for our samples simply involved moving the first shed cross close against the front warp beam, placing the cloth beam over the shed cross, and re-adjusting the backstrap to secure cloth beam and front warp beam together. With a shuttle filled with weft thread, weaving of the warp patterned cloth could commence.

A repeating sequence of six shed changes was needed to effect the woven designs with the sequence being: 1st heddle rod, 2nd heddle rod, beater 3, 1st heddle rod, beater 3, 2nd heddle rod. In elaborating on the shed change sequence to make it more directly available, it should be kept in mind that beater 3 in fact performed a somewhat different function from the first two beaters. Whereas the first two beaters basically facilitated different shed changes, they did not in themselves control specific shed openings. The three specific weaving sheds were always controlled by the 1st and 2nd heddle rods and beater 3. But at different times during the shedding sequence, beater 2 facilitated the movement of both the 2nd heddle rod and beater 3 sheds, while beater 1 in fact facilitated the shed movement of all three sheds.

The first weft was passed through the shed division held by beater 1 and the 1st heddle rod. It was secured by a shed change from the 2nd heddle rod; beater 2 was put on its side against the 1st heddle rod, thereby bringing down the shed secured by the 2nd heddle rod. Beater 1 was removed, then re-inserted in front of the first heddle rod to bring the shed cross down against the weft.

A second weft was secured with a shed change operating from beater 3. Beater 3 was put on its side against the 2nd heddle rod, and beater 2 removed and re-inserted to bring the shed cross down. When beater 2 was put on its side against the 1st heddle rod, the shed cross was brought down against the woven edge by re-positioning beater 1.

Weft 3 was secured by simply lifting the 1st heddle rod and re-positioning beater 1 to bring this shed down against the woven edge. The shed change to secure weft 4 was again from beater 3, but the manipulation used to secure it was slightly different from that used to secure weft pass 2. For weft 4, the beater 3 shed was held as well by beater 2, whereas for weft pass 2 the shed was held only by beater 3. All that was necessary this time was for beater 2 to be put on its side against the 1st heddle rod, and beater 1 to be re-positioned to bring the shed cross down against the weft.

Weft 5 was secured by the shed controlled by the 2nd heddle rod, but again the manipulation required was slightly different from that which secured weft pass 1. At weft pass 1, beater 2 already held the 2nd heddle rod shed, whereas at the beginning of the weft 5 shed movements, beater 2 held only the beater 3 shed. Therefore, to secure weft 5, the 2nd heddle rod was lifted and beater 2 re-positioned beneath to secure the shed. Beater 2 was then put on its side against the 1st heddle rod, and beater 1 re-positioned to bring the shed cross down against the woven edge. The sixth weft pass was secured by repeating exactly the same movements as had secured weft pass 3.

This sequence of six weft passes was repeated to effect the cloth, and once a rhythm developed there was nothing intrinsically difficult about the process. To maintain track of the correct shed change in each sequence, reference was made to the inverse of Maiz which developed on the upper cloth face (see Fig. 15). A bamboo tenter cut to width was fastened across beneath the cloth as soon as was practicable, and moved along as the weaving progressed. But from here on no new

technical variables were introduced, apart from the obvious re-adjustment of the backstrap to roll up the woven cloth. In the past, Mitla weavers normally stood to weave the longer and heavier cloth lengths, but our shorter samples were accomplished while sitting down.

It would seem from the foregoing analysis that Mitla cloth illustrates an interesting technical perspective not encountered in any other backstrap loom weaving except that of Pinotepa de Don Luis.[17] In the inventive use of warping sticks to establish the patterned twills, it opens up a quite different appreciation as to the capacities of, and the relationship between, warping and weaving sticks. The more usual plain weave shed cross established on the warping board for most other weaves does not integrate the warping sticks as an essential design tool of the woven product, whereas the procedure for Mitla cloth does.[18]

In association with the above, it would seem that the sequence in which one changes the sheds could alter the woven designs. One could in fact weave a plain 2/1 twill in the fondo area by repeating a 1st heddle rod, 2nd heddle rod, beater 3 sequence rather than reversing the twill by alternating with the 1st heddle rod, beater 3, 2nd heddle rod sequence. But this simple repetition of the first three shed changes would not produce the traditional Mitla design patternings. People at Mitla do not experiment with different warp and shed sequences for a variety of reasons, not the least of them being that in an oral tradition there are already an enormous number of complex weaving variables which must be committed to memory. Today the weaving of Mitla cloth continues on a treadle loom, although the warping and loom preparation for this apparatus do not require an understanding of the logics necessary for its production on a backstrap loom.

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NOTES

1. Irmgard Weitlaner Johnson, "Old Style Wrap-Around Skirts Woven By Zapotec Indians of Mitla, Oaxaca," p. 224. *Irene Emery Roundtable on Museum Textiles, 1976 Proceedings: Ethnographic Textiles of the Western Hemisphere*, ed. Irene Emery and Patricia Fiske, The Textile Museum 1976, pp. 238-255.

2. The sample piece measured 35cm by 76cm. It was not four selvedge.

3. The other two areas are: 1) Pinotepa de Don Luis, also in Oaxaca State, Mexico. Refer to Diana Ryesky, "Wrap-Around Skirts from Pinotepa de Don Luis, Oaxaca." *Irene Emery Roundtable on Museum Textiles, op. cit.* (note 1), pp. 256-269. 2) At present a tentative attribution only, to the pinatikan from the Minahassa region of North Celebes. Refer to Rita Bolland, "Weaving the Pinatikan, a Warp-Patterned Kain Bentenan from North Celebes." *Studies in Textile History*, ed. Veronica Gervers. Royal Ontario Museum, Toronto 1977, pp. 1-17, partic. pp. 9-10.

4. I.W. Johnson, *op. cit.* (note 1), p. 239.

5. In some areas of Mexico, women purchase a three strand acrylic yarn but then re-spin it with their spindles to provide the tight twist required for successful yarn handling on a backstrap loom. This practice was noted by the author at Temoaya (State of Mexico), Tetelcingo (Morelos), and Tenango de Doria (Hidalgo).

6. I.W. Johnson, *op. cit.* p. 242.

7. Johnson (*op. cit.* p. 245) gives Zapotec terminology for these design units: bi sie e (Cocol), sro ob (Maiz), bi suij (Rayas), and nagas (Fondo).

8. Unfortunately, Johnson (*op. cit.* p. 251) and Ryesky (*op. cit.* p. 265) are incorrect in implying that the structure is an alternating float weave according to Emery's classification. The confusion evidently arose because in Mitla cloth the weave is warp faced, as are most Mexican examples of alternating float weave (for instance, the well known belts of Santo Tomas Jalieza), and because the frequent reversal of the twill creates many 3/1 and 1/1 interlacings. Emery does not illustrate any 2/1 twills with reversals, but a similar effect occurs in other twills, as shown in her examples of 3/1 twill (*The Primary Structures of Fabrics*, The Textile Museum, 1966, pp. 102-105). In alternating float weave, alternate warps interlace 1/1 throughout, and all floats are 3-span (*op. cit.* pp. 114-115). Variations of this structure always have odd-numbered float spans, resulting from their plain weave derivation. Two span floats in a simple weave are indicative of twill. This analysis and explanation are courtesy of Ann P. Rowe.

9. Refer to Fig. 14 for an illustration of the relative position of loom sticks in the warp.

10. D. Ryesky, *op. cit.* p. 267.

11. I.W. Johnson, *op. cit.* p. 250.

12. Information courtesy Ann P. Rowe.

13. I.W. Johnson, *op. cit.* p. 244.

14. The warping for "eye" design at Pinotepa de Don Luis is the same as Maiz at Mitla, although only two "eyes" are normally warped in a pattern unit. See Ryesky, *op. cit.* p. 267.

15. Obviously some beaters are not wider than the average shed roll, e.g., those used to complete four selvedge cloth. Nevertheless, most beaters used during weaving of the main cloth area are wider than the accompanying shed roll.

16. Four selvedge weaving would also require a lease cord holding that shed division at the plain weave cross: in this case it is held by the securing rod.

17. According to the author's knowledge.

18. It would seem that one could in fact warp

Mitla cloth using only a plain weave shed cross (after all—the plain weave shed cross near the back warp post contains all those threads which follow different paths around posts 1, 2, and 3), but this method would still presume a knowledge of the color sequence in which to wind the warp threads. One would then have to insert beaters through the appropriate warp ends once the warps were transferred to the loom. Rita Bolland indicates (*op. cit.* p. 12) that a plain weave warping was used for the pinatikan, as well as a method which involved 8 warping pieces. In the case of Mitla cloth, however, (I cannot speak for the pinatikan) it would seem that a plain weave warping would be a more cumbersome alternative to the speed one can develop with knowledge of the warping logics elucidated by Adolfo.

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